나노 사이즈 폴리파이롤의 합성 조건에 따른 크기 변화

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Effect of Polymerization Conditions on the Size Development of Nano-sized PPy

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1. Introduction

Electrically conducting polymers have attracted a great deal of attention because of their unusual electronic properties.1 One of them, polypyrrole has been widely studieddue to its high conductivity and good environmental stability.2Especially polypyrrole nano-particles and -fibers are interesting because of their unique properties and applications. Recently amorphous polypyrrole nano-partlcles were fabricated using microemulsion polymerization at low temperature.3But this method has a weak point due to using the surfactant and low temperature. In this study, to obtain nanp-sized polypyrrole at room temperature, we synthesized polypyrrole by N2 bubbling with varying the alkyl chain length and concentration of dopant.

2. Experimental

2.1. Materials

Pyrrole was purchased from Aldrich Chemical Co.and distilled under reduced pressure. Ferric chloride (97%, Aldrich) was used as oxidant. Sodium p-toluene sulfonate (NaTS), sodium 4-octyl benzenesulfonate (NaOBS), sodium 4-dodecyl benzenesulfonate (NaDBS) and sodium 2-naphthalenesulfonate (NaNS) from Aldrich were used as dopants without further purification.

2.2. Synthesis

Variable amount of dopant was magnetically stirred in distilled water (10mL) at room temperature. Pyrrole monomer was supplied by bubbling of nitrogen gas as a carrier. Ferric chloride aqueous solution (0.65mol/L) was added dropwise into the above solution. After oxidation polymerization, the product was washed with distilled water and methanol several times to remove the residual ferric chloride and dopant.

2.3. Characterization

Infrared spectra of the samples were obtained on Perkin Elmer, spectrum GX FT-IR Spectrometer with KBr pellet method. Elemental analysis was performed with EA1110 (CE Instrument, Italy). The morphology of polypyrrole was observed by FE-SEM using JSM-6330F (Jeol, Japan) operating at 5kV, 12A after gold sputter-coating. The electronic conductivity of

polypyrrole doped with different benzenesulfonate anions measured by 45 Dual Display Multimeter (Fluke, U.S.A.)

3. Results and Discussion

The FT-IR spectrum (fig. 1)of the product showed characteristic PPy peaks at 1555,1470 and 784 cm-1which were due to ring stretching, conjugated C-N stretching, and C-H wagging vibrations, respectively. The particles synthesized appeared to be spherical, and their sizes varied from 50 to 130nm in diameter (fig.2). The polypyrrole particles prepared in NaDBS and NaNS aqueous solution have a relatively large diameter. As the concentration of dopant increased, the particle size shows a tendency to decrease.

4. Conclusions

Nano-sized polypyrrole was synthesized in the aqueous solution at room temperature. The size of the polypyrrole increased with increasing dopant alkyl chain length because the longer dopants have the enhanced flexibility.As the concentration of dopant aqueous solution increased, the polypyrrole particle size decreases due to the relative changes in interfacial and packing forces.

5. References

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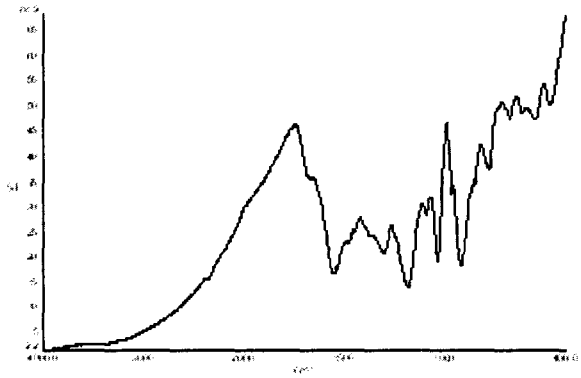

Fig. 1. IR spectrum of polypyrrole

Fig. 2. SEM image of polypyrrole doped NaDBS (0.025mol/L)